5505 RTD Analog Input Module

Installation, Operation and Maintenance
Setup Manual

5/19/2011

Schneider Electric

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed. Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Index of Figures

Safety Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

⚡	The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

⚠	This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠DANGER
DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠WARNING
WARNING indicates a potentially hazardous situation which, if not avoided, **can result** in death or serious injury.

⚠CAUTION
CAUTION indicates a potentially hazardous situation which, if not avoided, **can result** in minor or moderate.

CAUTION
CAUTION used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result** in equipment damage..

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved.

BEFORE YOU BEGIN

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠ CAUTION

EQUIPMENT OPERATION HAZARD

Verify that all installation and set up procedures have been completed.

Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.

Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in injury or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and grounds, except those grounds installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.

- Close the equipment enclosure door.

- Remove ground from incoming power lines.

- Perform all start-up tests recommended by the manufacturer.

OPERATION AND ADJUSTMENTS

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.

- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.

- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About The Book

At a Glance

Document Scope

This manual describes the operation and maintenance of the 5505 RTD Analog Input module.

Validity Notes

This document is valid for all versions of the 5505 RTD Analog Input module.

Product Related Information

> # ⚠ WARNING
>
> **UNINTENDED EQUIPMENT OPERATION**
>
> The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise should be allowed to program, install, alter and apply this product.
>
> Follow all local and national safety codes and standards.
>
> Failure to follow these instructions can result in death, serious injury or equipment damage.

User Comments

We welcome your comments about this document. You can reach us by e-mail at technicalsupport@controlmicrosystems.com.

Overview

The model 5505 RTD input module adds four RTD inputs to the 5000 input/output system. Up to sixteen Model 5505 modules may be connected to the I/O bus, for a total of 64 RTD inputs per bus. These RTD inputs are used with 3 or 4 wire 100 ohm platinum RTDs that conform to the 0.00385 ohms/ohm/°C calibration standard based on ASTM E 1137/E 1137M-04. Resistance from 0 to 500 ohms and RTDs from –200ºC to 800ºC can be measured.

The 5505 module scales and linearizes each RTD input and returns the individual data in ohms, °C, °F or K as a 32 bit floating point number.

For legacy applications the 5505 module can be configured to emulate a 5503 RTD input module. In the emulate mode the RTD inputs are scaled and linearized for one of six different input ranges as shown in the 5505 RTD Module user manual.

The 5505 module provides 4mA excitation current with a low duty cycle. The high excitation current along with the low duty cycle results in high accuracy while minimizing self-heating errors. The 5505 module can detect whether a 3 or 4 wire RTD has been wired and will excite and monitor the RTD accordingly.

The 5505 module uses a 24-bit delta sigma analog to digital (A/D) converter. A single chip microcontroller with integral watchdog timer operates the A/D, linearizes and scales the output data and communicates over the I/O bus.

Inputs are transient protected and optically isolated from the main logic power.

Installation

The installation of the 5505 module requires mounting the module on the 7.5mm by 35mm DIN rail and connecting the module to the system I/O Bus. Refer to the *System Configuration Guide*, at the beginning of this manual, for complete information on system layout, I/O Bus cable routing and module installation.

For ATEX and IECx applications only:

This equipment is to be installed in an enclosure certified for use, providing a degree of protection of IP54 or better. The free internal volume of the enclosure must be dimensioned in order to keep the temperature rating. A T4 rating is acceptable.

Field Wiring

Controller, modem and I/O modules use screw termination style connectors for termination of field wiring. They accommodate solid or stranded wires from 22 to 12 AWG.

The connectors are removable. This allows module replacement without disturbing the field wiring. Leave enough slack in the wiring for the connector to be removed.

Remove power before servicing unit.

To remove the connector:

- Pull the connector upward from the board. Apply even pressure to both ends of the connector.

To install the connector:

- Line up the pins on the module with the holes in the connector.

Push the connector onto the pins. Apply even pressure to both ends on the connector.

The 5505 module provides four RTD inputs for use with 3 or 4-wire RTDs. *Figure 1: Typical 5505 RTD Field* **Wiring** shows how to wire these RTDs.

When using **4 wire RTDs**, the four wires are connected to the Sense + (S+), Sense – (S–), Excitation Current + (I+) and Excitation Current – (I–) terminals. The I+ and I– terminals supply the excitation current to the RTD. The S+ and S– terminals return the sensed voltage to the 5505 module. 4 wire measurement techniques are the more accurate and consume the least amount of power. Although the circuitry and measurement technique can compensate for wiring resistance, the user should minimize the lead resistance as much as possible.

When using **3 wire RTDs**, three wires are connected to the Excitation/Sense + (I/S+), Sense – (S–) and Excitation Current – (I–) terminals. The I/S+ and I–

terminals supply the excitation current to the RTD. The S+ and S– terminals return the sensed voltage to the 5505 module. The Excitation Current + (I+) terminal is not used. The wiring resistance is monitored and compensated. In 3 wire installations the 3 wires are of the same length and type for this compensation to be accurately performed.

A DC supply powers the isolated RTD input circuits. A 5000 power supply, SCADAPack or TeleSAFE Micro16 normally sources this voltage. A range of voltages can be tolerated. Refer to the specifications for details.

In systems where multiple 5000 modules and other devices are connected to the DC power supply, it is possible for noise to be coupled into the DC power supply. For these reasons it is recommended that the negative side of the DC supply be connected to the panel or chassis ground. This connection can be made on the 5000 power supply, SCADAPack or TeleSAFE Micro16 terminal blocks or as part of the panel wiring.
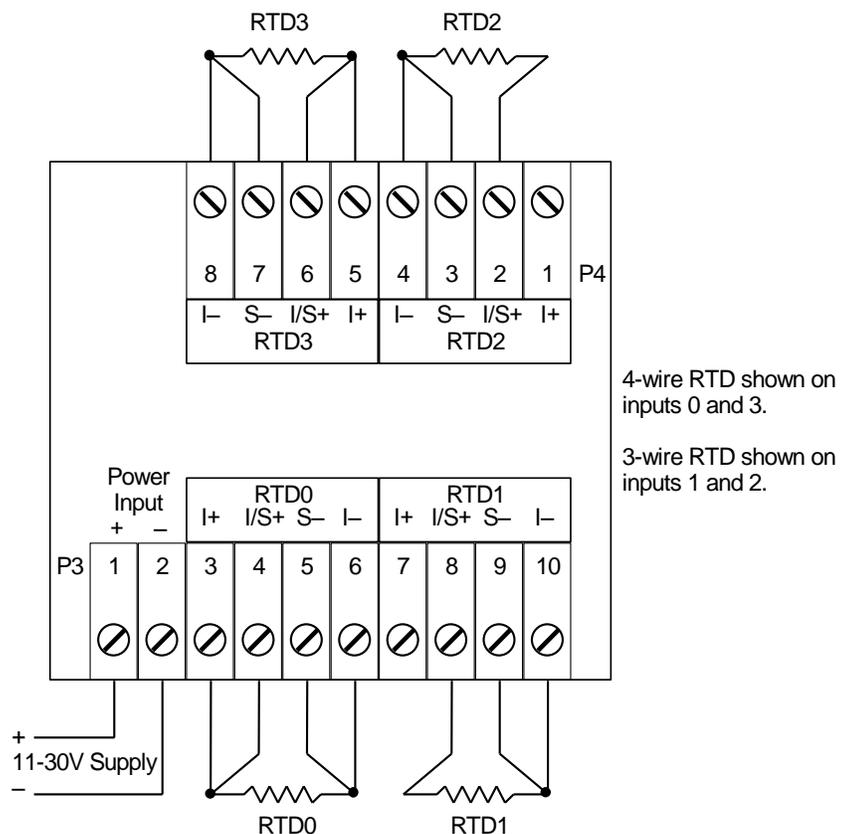

Figure 1: Typical 5505 RTD Field Wiring

DIP Switch Settings

Address Selection

The 5000 I/O bus will support a maximum of twenty I/O (input/output) modules. 5000 I/O module types may be combined in any manner to the maximum supported by the controller used. The types of input and output modules available are:

- Digital Input modules

- Digital Output modules

- Analog Input modules

- Analog Output modules

- Counter Input modules

Each type of I/O module, connected to the I/O bus, has a unique I/O module address. Different types of I/O modules may have the same module address.

The address range supported by the SCADAPack controller module may restrict the I/O module address range. Refer to the controller manual for the maximum address supported.

Each analog input module has a unique set of channels. The four address switches labeled 1, 2, 4 and 8 set the module address. To set the address:

- Open the four switches by sliding the actuator to the left side of the switch.

- Slide actuators to the right such that they total the desired address.

Figure 2: 5505 Analog Input Module Address **Switches** shows the switch setting for each of the 16 module addresses.
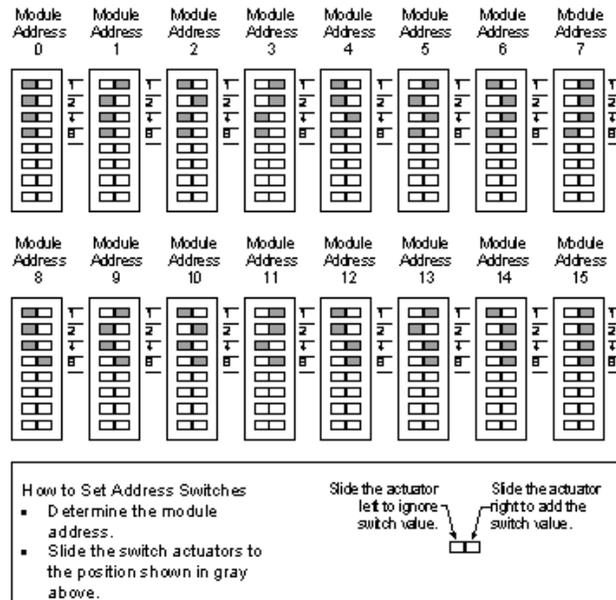
Figure 2: 5505 Analog Input Module Address Switches

5503 Emulation Range Selection

The 5505 module measures resistance in the 0 to 400 ohm range and scales and linearizes the data depending on the RTD range selected when in 5503 Emulation Mode. These ranges are summarized in the table below.

Range	RTD Range
0 to 200ºC	0
−100 to+100ºC	1
−200 to 0ºC	2
0 to 800ºC	3
0 to 400ºC	4
0 to 400 ohms	5

Figure 3: 5503 Emulation Module RTD Range **Switches** shows the switch settings for the six possible ranges.

Range 0 Range 1 Range 2 Range 3 Range 4 Range 5
0 to 200ºC −100 to 100ºC −200 to 0ºC 0 to 800ºC 0 to 400ºC 0 to 400 ohms

How to Set Range Switches
- Determine the desired range.
- Slide the switch actuator the gray position shown above.
- Range Switch applies in 5503 Emulation Mode only. The "EMU" switch is ON.
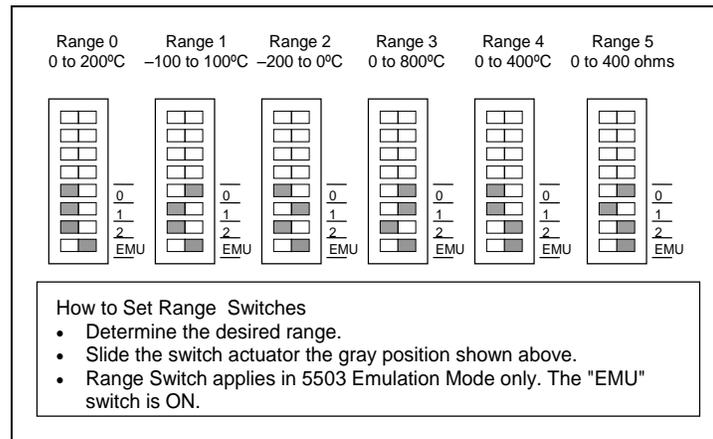
Figure 3: 5503 Emulation Module RTD Range Switches

5503 Emulation Mode Switch

The 5505 can be configured to return data in the same format as that used by the 5503 RTD module. In this mode no program changes or software upgrades are required to replace a 5503 RTD module with a 5505 RTD module.

Set the 5503 Emulation Mode Switch to the right or 5503 position to configure the 5505 RTD to return data in the 5503 format. See *Figure 4: 5503 Emulation Switch*

5505
Mode

5503
Emulation
Mode

How to set the 5503 Emulation Mode Switch
- Slide the switch actuator the gray position shown above.
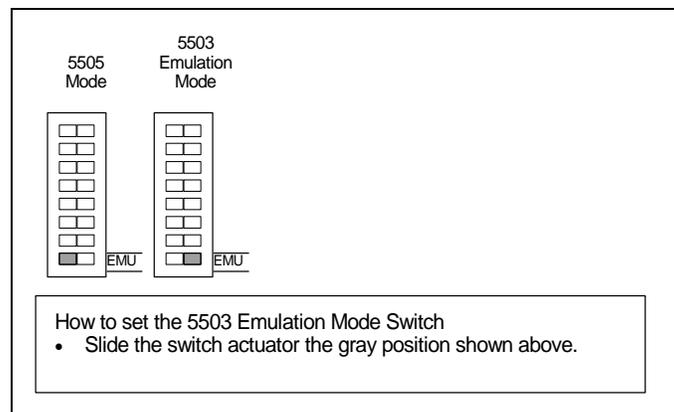
Figure 4: 5503 Emulation Switch

Operation and Maintenance

The 5505 RTD module can operate in native mode or in 5503 RTD emulate mode. In emulate mode the 5505 RTD module operates as a 5503 RTD module.

5505 Native Mode

The 5505 RTD module native mode provides enhanced capability over the 5503 emulation mode. The module operates in native mode if the 5503 Emulation DIP switch is open. This mode is recommended for new installations.

Each input is individually configurable for resistance measurement or RTD temperature measurement

Each RTD input is configurable to return the measured temperature in degrees Celsius, Kelvin, or Fahrenheit.

Inputs have a common configurable filter rate that can be used to dampen process variations or noise.

The module returns diagnostic and status information for each input, such as RTD type (3 or 4 wire), open RTD annunciation, and RTD out of range annunciation.

- Data is returned as an IEEE 32 bit, single precision floating point number that requires no additional scaling.

Data Format

The 5505 module returns RTD resistance and temperature data and RTD input status data. The RTD data and status is returned via one of the following methods:

- For **Telepace** applications the RTD and status data is returned using the **AIN 5505** register assignment module. Refer to the Telepace User and Reference Manual for details on configuring the register assignment.

- For **IEC 61131-1** applications the RTD and status data is returned using the I/O Connection **sp5505** Complex Equipment. Refer to the IEC 61131-1 User and Reference Manual for details on configuring the I/O Connection.

The following table shows the data output for ^{o}C, ^{o}F, ^{o}K, and Ohms for the 5505 RTD module.

Temperature	Condition	Output
<-200ºC	out of range	-200
-200ºC	operating	-200
800ºC	operating	800
>800ºC	out of range	800

Temperature	Condition	Output
<-328ºF	out of range	-328
-328ºF	operating	-328
1472ºF	operating	1472
>1472ºF	out of range	1472
<73.15K	out of range	73.15
73.15K	operating	73.15
1073.15K	operating	1073.15
>1073.15K	out of range	1073.15
0 ohms	under-range	0
500 ohms	operating	500
>500 ohms	out of range	500

Special Conditions

In 5505 module output data has two special conditions.

- If the RTD is open the data goes to full scale.

- If the 11-30Vdc power supply is off the data goes to 0.

Status

The 5505 module Input Status Registers return the following data.

- RTD open or good

- RTD is in or out of range

- RTD is using a 3-wire or 4-wire measurement.

When the Compatibility Mode Switch is set to 5503 the Status registers are not available

Status Register	Function
0	0 = channel 0 RTD is good 1 = channel 0 RTD is open or PWR input is off
1	0 = channel 0 data is in range 1 = channel 0 data is out of range
2	0 = channel 0 RTD is using 3-wire measurement 1 = channel 0 RTD is using 4-wire measurement
3	Not used.
4	0 = channel 1 RTD is good 1 = channel 1 RTD is open or PWR input is off
5	0 = channel 1 data is in range 1 = channel 1 data is out of range

Status Register	Function
6	0 = channel 1 RTD is using 3-wire measurement
	1 = channel 1 RTD is using 4-wire measurement
7	Not used.
8	0 = channel 2 RTD is good
	1 = channel 2 RTD is open or PWR input is off
9	0 = channel 2 data is in range
	1 = channel 2 data is out of range
10	0 = channel 2 RTD is using 3-wire measurement
	1 = channel 2 RTD is using 4-wire measurement
11	Not used.
12	0 = channel 3 RTD is good
	1 = channel 3 RTD is open or PWR input is off
13	0 = channel 3 data is in range
	1 = channel 3 data is out of range
14	0 = channel 3 RTD is using 3-wire measurement
	1 = channel 3 RTD is using 4-wire measurement
15	Not used.

5503 Emulation Mode

Data Format

In 5503 Emulation Mode the 5503 module uses 16 bit signed numbers (15 bits plus sign). The ADC output is scaled and linearized to provide output data in a 16 bit signed format.

For example on the 0 to +200ºC range, after scaling and linearization, a temperature of 130ºC will generate an output of (130/200) X 32768=21299.

The table below shows the output values for several input signals based on the 0 to +200ºC range.

Temperature	Condition	Output
<0ºC	operating	0
0ºC	operating	0
0.02ºC	operating	3
100ºC	operating	16384
130ºC	operating	21299
199.98ºC	operating	32764
200ºC	operating	32767
NA	open RTD	32767
NA	+24V off	0

Special Conditions

In 5503 Emulation Mode the 5505 module output data has two special conditions.

- If the RTD is open the data goes to full scale.

- If the 11-30Vdc power supply is off the data goes to 0.

Maintenance

This module requires no routine maintenance. If the module is not functioning correctly, contact Control Microsystems Technical Support for more information and instructions for returning the module for repair.

Troubleshooting

Condition	Action
Inputs read 0.	Check power. Check range.
Inputs read 32767.	Check for open RTD. Check range.
Reading is constant.	Check that the analog input is not forced.
Appears to be on wrong range.	Reset is required from the bus controller to read the RTD range switches.

Refer to the Status Registers for additional information when diagnosing the module.

Calibration

The 5505 module is calibrated at the factory. It does not require periodic calibration. Calibration may be necessary if the module has been repaired as a result of damage. Calibration is done electronically at the factory. There are no user calibration procedures.

Specifications

Disclaimer: Control Microsystems reserves the right to change product specifications. For more information visit *www.controlmicrosystems.com* .

General

I/O Terminations	12 to 22 AWG
	15A contacts
	Screw termination - 6 lb.-in. (0.68 Nm) torque
Dimensions	2.9 inch (74 mm) wide
	4.9 inch (124 mm) high
	1.8 inch (45 mm) deep
Packaging	corrosion resistant zinc plated steel with black enamel paint
Environment	5% RH to 95% RH, non-condensing
	-40°C to 70°C (-40°F to 158°F) operation
	-40°C to 85°C (-40°F to 185°F) storage
Addressing	16 modules. DIP switch selectable.

RTD Inputs

Quantity	4
Type	100 ohm platinum 0.385 ohms/°C
	ASTM E 1137/E 1137M-04
	ITS-90
	3 and 4 wire. Auto detection and compensation.
5505 Ranges	Can be configured to return data in ohms, °C, °F or K.
	-200 to 800°C
	0 to 500 ohms
5503 Emulation Ranges	DIP switch selectable.
	0 to 200°C
	-100 to $+100^{o}$C
	-200 to 0°C
	0 to 800°C
	0 to 400°C
	0 to 400 ohms
Data format	5505: 32 bit floating point and 12 status bits

	5503 Emulation: 16 bit signed number
Resolution	5505: >17 bits effective
	5503 Emulation: 15 bits
RTD Status	RTD is good (not open)
	RTD in range
	RTD 3/4 wire
	RTD status not available in 5503 Emulation
Accuracy on RTD ranges	percent of full scale over operational temperature range including linearization errors:
	+0.10%/–0.05%
Accuracy on 0 to 500 ohms	Percent of full scale over operational temperature range: ±0.03%
Excitation Current	4mA, 7.2% duty cycle in 4-wire mode, 14.4% in 3-wire mode, 250ms scan interval.
Line resistance	100 ohms max., in each line
Converter type	24 bit delta-sigma
Response Time	380 ms typical for 10% to 90% signal change at minimum filter setting
Transient Protection	2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Connectors	Two removable. 10 positions (Power, RTD0, RTD1), 8 positions (RTD2, RTD3)
Isolation	Isolation from logic supply and chassis. Voltage 500Vrms

Power Supply

5V power requirements	6mA
11-30Vdc power requirements	UL508 rated 13.75-28Vdc. Class 2.
	12V operation: 4mA
	plus 0.6mA per 4 wire RTD
	plus 1.2mA per 3 wire RTD
	24V operation: 2.2mA
	plus 0.3mA per 4 wire RTD
	plus 0.6mA per 3 wire RTD
11-30Vdc - Connector	Removable. Shared with the RTD Inputs 0-1.
11-30Vdc - Isolation	Isolation from logic supply and chassis

Approvals and Certifications

Hazardous Locations - North America	Suitable for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations. Temperature Code T5 CSA certified to the requirements of: • CSA Std. C22.2 No. 213-M1987 - Hazardous Locations. • UL Std. No. 1604 - Hazardous (Classified) Locations.
Hazardous Locations - Europe	ATEX II 3G, Ex nA IIC T4 per EN 60079-15, protection type n (Zone 2)
Hazardous Locations	IECEx, Ex nA IIC T4 per IEC 60079-15, protection type n (Zone 2)
ATEX and IECEx Applications only	This equipment is to be installed in an enclosure certified for use, providing a degree of protection of IP54 or better. The free internal volume of the enclosure must be dimensioned in order to keep the temperature rating. A T4 rating is acceptable. For products using Solid State Relays (5415, 5606 and 5607 modules and SCADAPack using 5606 and 5607 modules) A T4 rating is acceptable for maximum loads of 2A. When 3A loads are connected to the Solid State Relays, the maximum ambient rating is lowered to 50°C in order to maintain the T4 rating.
Safety	CSA (cCSAus) certified to the requirements of: CSA C22.2 No. 142-M1987 and UL916. (Process Control Equipment, Industrial Control Equipment) in Canada and USA. UL (cULus) listed: UL508 (Industrial Control Equipment)
Digital Emissions	FCC Part 15, Subpart B, Class A Verification EN61000-6-4: Electromagnetic Compatibility Generic Emission Standard Part2: Industrial Environment C-Tick compliance. Registration number N15744.
Immunity	EN61000-6-2: Electromagnetic Compatibility Generic Standards Immunity for Industrial Environments
Declaration	This product conforms to the above Emissions and Immunity Standards and therefore conforms with the requirements of Council Directive 2004/108/EEC (as amended) relating to electromagnetic compatibility and is eligible to bear the CE mark.

The Low Voltage Directive is not applicable to this product.